

# Claims

What is claimed is:

1. Hydraulic annular washing column for continuously separating solids from a suspension comprising:

5 a hollow cylindrical column having a central axis therethrough, said column having an interior with a cross-section, perpendicular to said axis, that is constant along said axis, and that extends from a first end to a second end of said column;

one central cylinder axially disposed in said column and extending from said one end toward said opposite end, said central cylinder having an outer wall of constant diameter, said cylindrical column and said central cylinder defining an annular zone between them, extending axially from said first end of the column to at least near said second end of the column;

at least one filter in said outer wall of said central cylinder, forming the only direct communication between said annular zone and the interior of the cylinder and at least one filter in the outer wall of said hollow cylindrical column;

means for supplying a suspension to said first end of the column;

means for removing suspension at said second end of the column;

said annular zone defining a concentration zone and optionally a washing zone;

means communicating with the interior of said central cylinder for removing liquid passed through said filter in said outer wall of said central cylinder and means for removing liquid passed through filter in the outer wall of said hollow cylindrical column; and

hydraulic means, continuously acting on the suspension for urging the liquid through said annular zone towards said filters and for forming a packed bed of solids moving continuously in an axial direction towards said second end.

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2. Column according to claim 1, wherein two or more filters are present in said central cylinder or said outer wall, or both.

3. Column according to claim 1, wherein a ratio of an inner diameter of said column to an outer diameter of said cylinder is between 1.5 and 4.

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4. Column according to claim 1 , wherein a wall to wall distance of the annular zone is between 20 and 150 cm.
5. Column according to claim 1 , wherein an inner diameter of said column is at least 30 cm.
6. Column according to claim 1 , wherein one or more of the number, height and location of the filter(s) are used as design parameters for optimization of the wash front profile or to minimize the friction between the bed and said wall(s), or both.
7. Column according to claim 1 , wherein one or more control valves are present to control the flow of liquid through the filters, thereby providing independent control of the liquid flow through the filters in said central cylinder and said outer wall.
8. Column according to claim 1 , wherein either mechanical or physical means are present at said second end for disintegrating a packed bed of solids.
9. Column according to claim 8, wherein said mechanical means are selected from scrapers and screws.
10. Column according to claim 8, wherein said physical means include a liquid disintegration jet, or a melting zone.
11. Column according to claim 1, which column does not have mechanical means for transport of the packed bed through the column.
12. Process for continuously separating solids from suspension thereof in a liquid, said process comprising providing a suspension of solids in a liquid to a column according to claim 1, thereby forming a packed bed of said solids in said annular treatment zone, continuously withdrawing liquid from said suspension through said filters, and removing part of the packed bed at said second end of the column, the transport of the bed through the column being provided by gravity or hydraulic means, or both.

13. Process according to claim 12, wherein control of the flow of the liquid through the filters is used to regulate the friction between the packed bed and the filter-walls.
14. Process according to claim 12, wherein said suspension undergoes one or more of a  
5 concentrating, washing, impregnating, leaching, extracting and separating treatment.
15. Process according to claim 14, wherein the treatment comprises concentrating by crystallization of beverages, desalination of sea water or purification of organic materials.
- 10 16. A hydraulic annular washing column for continuously separating solids from a suspension, the column comprising:  
a hollow cylindrical column having a central axis, a column wall and an interior that extends from a first end of the column to a second end;  
one central cylinder axially disposed in said column and extending from said first end  
15 toward said second end, said central cylinder having a cylinder wall and a cylinder interior, said cylindrical column and said central cylinder defining an annular zone between them, the annular zone extending axially from the first end of the column to at least near the second end of the column;  
at least one first filter in the central cylinder wall, said at least one first filter forming  
20 the only direct communication between said annular zone and the cylinder interior;  
at least one second filter in the column wall;  
a first inlet for supplying a suspension to said first end of the column;  
a first outlet for removing product at said second end of the column;  
a first filtrate outlet for removing liquid passed through said at least one first filter;  
25 and  
a second filtrate outlet for removing liquid passed through said at least one second filter,  
wherein the suspension is continuously urged through said annular zone and towards said filters without separate mechanical means.  
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17. The apparatus according to claim 16, further comprising a filtrate chamber connected to the column wall and configured to receive liquid passing through the at least one second

filter, the filtrate chamber connected to said second filtrate outlet.

18. The apparatus according to claim 16, wherein at least two filters are present in either the cylinder wall, or the column wall, or both.

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19. The apparatus according to claim 16, wherein a ratio of an inner diameter of said column to an outer diameter of said cylinder is between 1.5 and 4.

20. The apparatus according to claim 16, wherein a wall to wall distance of the annular zone is between 20 and 150 cm.

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21. The apparatus according to claim 16, wherein an inner diameter of said column is at least 30 cm.

22. The apparatus according to claim 16, further comprising one or more control valves arranged to control a flow of liquid through the filters.

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23. The apparatus according to claim 16, wherein mechanical or physical means are present at said second end for disintegrating a packed bed of solids.

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24. The apparatus according to claim 23, wherein said mechanical means comprises scrapers, screws, or both.

25. The apparatus according to claim 24, wherein said physical means comprises a melting zone.

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26. A process for continuously separating solids from suspension thereof in a liquid, said process comprising:

providing a column having first and second ends and a column wall, and a cylinder having a cylinder wall, the cylinder being axially located in the column so as to form an annular zone therebetween;

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introducing a suspension of solids in a liquid into the annular zone near the first end of the column;

continuously withdrawing a first portion of said liquid through a first filter in said cylinder wall and continuously withdrawing a second portion of said liquid through a second filter in said column wall, thereby forming a packed bed in said annular zone; and

5 removing at least a portion of said packed bed at the second end of the column,  
wherein the packed bed is transported through said annular zone without mechanical means.

27. The process according to claim 26, comprising controlling a flow of liquid through said first and second filters to regulate friction between the packed bed and walls of the  
10 filters.

28. The process according to claim 26, further comprising treating said suspension by one or more of concentrating, washing, impregnating, leaching, extracting and separating.

15 29. The process according to claim 28, wherein said treating comprises concentrating by crystallization.